Study on the selenium colloidal solution (Commemoration volume dedicated to Prof. Shinkichi Horiba in celebration of his sixtieth birthday)

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STUDY ON THE SELENIUM COLLOIDAL SOLUTION.

By Kiyoshi Juna.

By using selenium dioxide and hydrazine hydrate to obtain selenium colloidal solution are often studied.[1-6]

But with all these methods we can not obtain stable and concentrated solution.

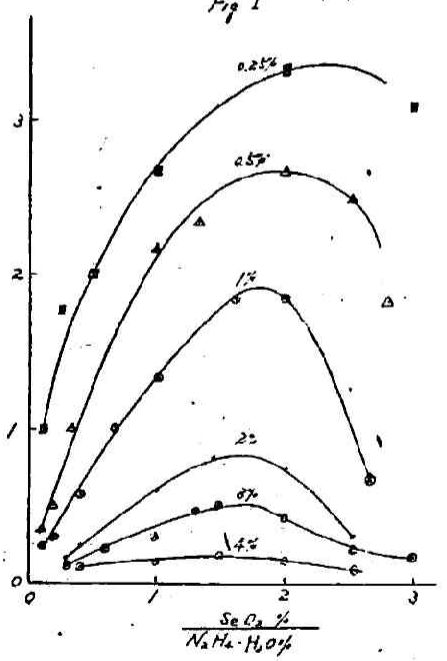
So auther adopted new method to prepare a stable colloidal solution, and obtained good result. Now explain the method and indicate the coagulation value of the colloidal solution.

(I) The Process of The Preparation of Colloidal Solution.

(a) Reduction of Selenium Dioxide.

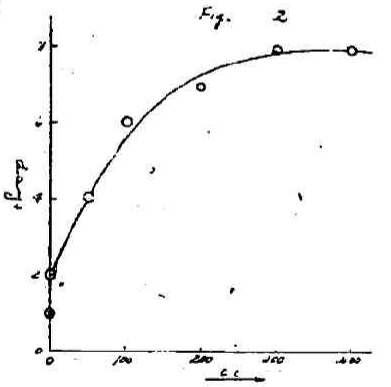
At first added 10 c.c. of selenium dioxide solution to a boiling 250 c.c. of distilled water, then at once 10 c.c. of hydrazine hydrate solution. Reduction occured, and measured the time necessary to appear opalescence in the solution.

Fig 1



Time of app. of Opalescence (min.)

Fig. 2



1) A. Gutbier, *Zeit. Anorg. Chem.*, 32, 106 (1902)
2) ,, *Koll. Zeit.*, 4, 260 (1909)
3) ,, *Koll. Beiheft.*, 4, 413 (1913)
4) A. Gutbier and Einslander, *Koll. Zeit.*, 31, 33 (1922)
5) J. Huber, *Koll. Zeit.*, 32, 255 (1923)
6) U. Rhein, *Koll. Zeit.*, 33, 35 (1923)

250 c.c. H_2O + 10 c.c. (SeO_2 X%) ← 10 c.c. ($N_2H_4H_2O$ Y%)

In this case changed values of X and Y, and studied.

So obtained following curves in Fig. 1.

(b) Stability and Dilution.

Among the above experiments, choiced the best following condition.

250 c.c. H_2O 10 c.c. (SeO 5%).....10 c.c. ($N_2H_4H_2O$ 2.4%)

After continuing boiling 40 seconds, poured it into different amounts of ice cooled distilled water, and compared the stability of solutions.

With this one series of experiments obtained a curve shown in Fig. 2. From the curve prefered to use 250～300 c.c. of water.

Then concluded following process for the preparation of selenium colloidal solution.

"Add 500 c.c. of distilled water to one liter Jena Glass beaker and heat on electric-heater. After boiling add 20 c.c. of 3% SeO_2 solution and then 20 c.c. of 2.4% $N_2H_4H_2O$ solution. After continuing the boiling 40 seconds, pour it into 50 c.c. of ice cooled distilled water, and wait until become to 20°c.

With this method obtained colloidal solution which had selenium 27.5 mg./liter, and particle size was $r = 30$ mm. (selenium is negative crystal but for convenience taken to be sphere.)

(II) Measuring Method of Determing Coagulation Value and Coagulation Value.

On the colloidal solution, which was obtained above, measured coagulation value by the method of auther. The results was as follows.

Coag. Val. / Salt	$C\left(\frac{\text{m.mol}}{\text{liter}}\right)$	$\frac{1}{C}$	$\frac{1}{C}$ by Doolan[3]
Nacl	140.0	0.007	0.025
$Bacl_2$	3.3	0.303	0.741
$Alcl_3$	0.04	25.000	10.000

Now let us compare with coagulation values of gold and sulphur colloidal solution.

From the results find good coincidence with sulphur and selenium.[7-9]

7) K. Juna, Report of Osaka Industrial research Institute No. 12, Heft 2.
8) Freundlich and Scholz, *Koll. beiheft.*, 234, 1316 (1922)
9) J. Doolan, *J. Phys. Chem.*, 29, 178 (1925)

Observer	Auther	Freundlich and scholz	Auther
Coll. Solution	Au	S (Oden's Method)	Se
Coag. Val. / Salt.	M. Mol / liter	M. Mol / liter	M. Mol / liter
Nacl	29.0	130.0	140.0
$BaCl_2$	0.2	1.8	3.3
$AlCl_3$	0.007	0.04	0.04

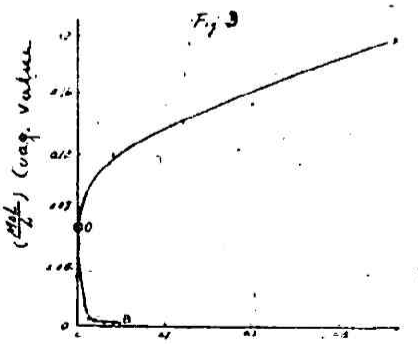
(III) Influence of Hydrazine Hydrate and Selenium Dioxide on the Stability of Selenium Colloidal Solution.

Coagulation Value of selenium Colloidal solution, which had ellapsed 5 monthes after preparatibn, was influenced by hydrazine hydrate and selenium dioxide.

Next table indicate the results.

Coag. Valve by Nacl $\left(\frac{\text{M. Mol}}{\text{liter}}\right)$	Added $N_2H_4H_2O$ (%)	Added $N_2H_4H_2O$ (Mol)
66	0.0	0.0
120	0.04	0.008
140	0.12	0.024
150	0.20	0.040
200	0.34	0.068

From results observe that hydrazine hydrate as stabilizer and selenium dioxide as coagulater inflences. (Fig. 3)



Summary.

To obtain stable colloidal solution of selenium adopt selenium dioxide and hydrazine hydrate.

1. The process is as follows:

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a) Formation made at boiling state.

b) Boiling Colloidal solution is poured into cold distilled water.

c) The colloidal solution is dialyzed with perchment paper.

2. The colloidal solution has following coagulation Values.

Nacl	140.0	$\left(\frac{\text{M. Mol}}{\text{liter}}\right)$
$Bacl_2$	3-3	"
$Alcl_3$	0.04	"

3. Hydrazine Hydrate acts as stabilizer for selenium colloidal solution but selenium dioxide as coagulater.

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